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Faced with the problem of disposing of thousands of tons of orange pulp, the annual residue from their manufacturing processes, the Exchange Orange Products Company, of San Dimas, California, appealed to the University for assistance in determining the value of this waste as a feed for livestock. The results of investigations begun for this purpose by the Division of Animal Husbandry in the fall of 1924 show that dried orange pulp is a satisfactory feed for dairy cows, having a value for milk production approximately equivalent to that of dried beet pulp, and that neither dried nor fresh orange pulp has any effect upon the butterfat tests.

Orange pulp consists of the rind, flesh, and seeds of the orange, and a small amount of the unrecovered juice, oils, and other extracts. It is a heavy wet mass having the following approximate composition: Moisture 80.03 per cent; crude protein 1.71 per cent; nitrogen free extract 15.23 per cent; crude fiber 1.61 per cent; ether extract .75 per cent; and ash .67 per cent.

The manufacture of orange by-products is rapidly increasing with a consequent increase in residue which must be disposed of by the factory. During the year ending December 31, 1924, the Exchange Orange Products Company, the principal manufacturers of these by-products produced more than 9000 tons of the wet pulp at their San Dimas plant. They estimate that by 1930 the volume will be 50,000 tons. The disposal of this residue is, therefore, presenting yearly a more serious problem to the manufacturers.

The first extensive attempt to utilize fresh orange pulp as a feed for livestock was made by Mr. Frank Pellissier on his dairy ranch near Whittier, California, in the summer of 1922. The results were so satisfactory that the demand for the wet pulp rapidly increased. However, because it decomposes so quickly and has such a high moisture content, its use has been restricted to those dairy farms within trucking distance of the factory. These are able to use only a small portion of the total amount.

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The Exchange Orange Products Company, therefore, conceived the idea of dehydrating the fresh pulp and marketing it as a livestock feed. For the purpose of determining its value as a feed for milk production, the first experiment described below was undertaken.

DRIED ORANGE PULP

The orange pulp used in this trial was obtained from the factory where it was dried in temporary equipment to approximately 12.5 per cent moisture. It was then ground. The resulting product had very much the appearance of fine corn meal.

METHOD OF PROCEDURE

Eight cows as nearly uniform as possible in weight, stage of lactation, and gestation, were selected from the University herd. They were divided into two lots. Group A consisted of the following cows: Nos. 20, 108, 106, and 327; group B, of Nos. 121, 326, 334, and 357.

Since the value of dried beet pulp for milk production is known,[1] and since its chemical analysis is similar to that of dried orange pulp, the former was used in this trial as the standard of comparison.

The feeding trial was divided into two periods of 60 days each. During period 1 the animals in group A received alfalfa hay plus a concentrate mixture consisting of equal parts, by weight, of wheat bran and dried orange pulp. Group B, during the same time, received alfalfa hay plus a concentrate mixture consisting of equal parts, by weight, of wheat bran and dried beet pulp. During period 2, group A received the concentrate mixture containing dried beet pulp and group B that containing dried orange pulp.

Every ten days throughout the experiment the requirements of each animal for both maintenance and milk production were calculated, and the amounts of feed adjusted. An attempt was made to supply the alfalfa hay in quantities sufficient to satisfy the maintenance requirements of each animal. The concentrate mixture fed was calculated to supply the requirements for milk production.

Each cow was milked twice daily, her milk being weighed at each milking. A daily composite sample was taken and its percentage of butterfat determined. Chemical analyses were made of all feeds used, and an accurate account was kept of the feed consumed by each cow. To ascertain its weight at the beginning of the experiment, each animal was weighed on three consecutive days and the average taken. At ten-day intervals throughout the experiment, this procedure was repeated.

PRESENTATION OF DATA

Period 1 lasted from December 18, 1924, to February 15, 1925, and period 2, from February 16 to April 16, inclusive.

To determine the amount of feed each cow should receive, the Armsby[2] standard for maintenance and milk production was used. The body weight and milk and fat production at the beginning of each ten-day period constituted the basis for calculating the individual daily requirements. The energy furnished by the feed was ascertained by the Armsby and Fries[3] method for computing the approximate net energy value of a feeding stuff.

TABLE 1

COMPOSITION, DIGESTIBILITY AND NET ENERGY VALUES OF FEEDS USED

Feeding stuff	Water	Crude protein		Nitrogen free extract		Crude fiber		Ether extract		Net energy
	Per cent	*Per cent*	*Coefficient of digestibility*	*Per cent*	*Coefficient of digestibility*	*Per cent*	*Coefficient of digestibility*	*Per cent*	*Coefficient of digestibility*	*Therms**
Wheat bran [4] Period 1	13.94	15.73	78.0	52.06	72.0	9.50	31.0	2.98	68.0	50.91
Wheat bran Period 2	9.93	17.37	78.0	52.69	72.0	9.18	31.0	4.85	68.0	53.92
Dried beet pulp [4], Period 1	11.61	8.52	52.0	58.30	83.0	18.31	83.0	0.86	.....	74.57
Dried beet pulp Period 2	10.24	8.86	52.0	57.13	83.0	20.17	83.0	0.97	.....	75.33
Dried orange pulp [5], Period 1	12.75	7.56	78.5	66.81	95.4	7.87	83.7	1.68	48.9	89.84
Dried orange pulp, Period 2	11.44	7.85	78.5	68.03	95.4	8.24	83.7	1.03	48.9	91.59
Alfalfa hay [5] Both periods	9.73	15.49	77.0	38.46	73.5	25.66	48.5	1.85	20.3	36.92

* Value per 100 pounds for ruminants, calculated according to Armsby and Fries.

Table 1 gives the percentage composition, digestibility, and net energy values of the feeds used in this experiment. The net energy received by each animal during the feeding trial was derived by applying the coefficients of digestibility to chemical analyses made at this station. The coefficients of digestibility for wheat bran and dried beet pulp were taken from Henry and Morrison.[4] Those for alfalfa hay and orange pulp were determined by Mead and Guilbert.[5]

The accuracy with which the amount of feed needed by each cow was determined is shown in table 2. It was estimated that the four cows in group A would require 3404.3 therms of net energy during period 1. The feed they received actually furnished 3681.6 therms, thus exceeding the requirements by 277.2 therms or 8 per cent.

During period 2, they received an excess of 159.1 therms of net energy, or about 5 per cent. The four cows in group B received during period 1, 134.4 fewer therms than had been calculated for their requirements, or a deficit of approximately 5 per cent, and during period 2, 176.3 more therms than had been calculated, or an excess of almost 7 per cent.

TABLE 2

FEED CONSUMED

A comparison of net energy required and that received

Cow No.	Period 1					Period 2				
	Pounds of feed eaten		Therms of net energy			Pounds of feed eaten		Therms of net energy		
	Alfalfa hay	Concentrates	Required	Received	Difference	Alfalfa hay	Concentrates	Required	Received	Difference
		(1)					(2)			
20	537.3	789.8	728.5	754.2	+ 25.7	596.6	676.0	668.4	657.1	− 11.3
108	877.1	1237.4	1097.0	1194.6	+ 97.6	879.0	1024.0	915.5	986.2	+ 70.7
106	970.5	722.5	720.7	866.7	+146.0	986.6	608.0	629.7	757.1	+127.4
327	577.9	927.6	858.1	866.1	+ 8.0	544.4	842.1	772.9	745.2	− 27.7
Group A, total	2962.8	3677.3	3404.3	3681.6	+277.3	3006.6	3150.1	2986.5	3145.6	+159.1
		(2)					(1)			
121	590.8	795.5	752.5	717.2	− 35.3	586.5	710.3	697.3	733.3	+ 36.0
326	534.1	522.1	536.5	524.8	− 11.7	534.8	462.0	505.1	533.6	+ 28.5
334	561.2	552.3	580.6	553.7	− 26.9	624.9	417.1	479.0	534.2	+ 55.2
357	647.4	1019.7	939.3	878.8	− 60.5	644.0	884.1	824.2	880.9	+ 56.7
Group B, total	2333.5	2889.6	2808.9	2674.5	−134.4	2390.2	2473.5	2505.6	2682.0	+176.4

(1) Dried orange pulp and wheat bran, equal parts by weight.
(2) Dried beet pulp and wheat bran, equal parts by weight.

The nutrients consumed by a dairy cow in excess of the amount required for maintenance result in either production of milk or increased body weight. Therefore, to determine the efficiency of dried orange pulp as compared with dried beet pulp for production, it was necessary to measure the effect not only upon milk and butterfat production but upon body weights as well.

The total average weight of the cows in group A was 5029 pounds during period 1, as is shown in table 3. When the dried beet pulp replaced the dried orange pulp in the ration during period 2, their total average body weight was 5049 pounds. For group B, the total average body weight during period 2, when dried orange pulp was being fed, was 4179 pounds; during period 1, this weight was 4151 pounds. The difference of 20 pounds for group A and of 28 pounds for group B, when divided among the individual animals, is well within the error of weighing.

TABLE 3

INDIVIDUAL BODY WEIGHTS

(Pounds)

Weighing dates	Group A					Group B				
	Cow No.				Group total	Cow No.				Group total
	20	108	106	327		121	326	334	357	
December:										
16–17–18	934	1449	1647	1003	5033	1077	917	1085	1172	4251
26–27–28	933	1480	1665	965	5043	1051	914	1053	1172	4190
January:										
7– 8– 9	910	1458	1645	947	4960	1025	893	1023	1161	4102
17–18–19	928	1493	1681	952	5054	1016	905	1043	1147	4111
27–28–29	936	1484	1693	931	5044	1023	891	1043	1147	4104
February:										
6– 7– 8	922	1477	1674	910	4983	1003	899	1073	1138	4113
16–17–18	946	1483	1709	949	5087	1027	918	1089	1155	4189
Average, period 1	930	1475	1673	951	5029	1032	905	1058	1156	4151
February:										
16–17–18	946	1483	1709	949	5087	1027	918	1089	1155	4189
26–27–28	955	1478	1690	931	5054	1010	907	1049	1144	4110
March:										
8– 9–10	959	1451	1725	957	5092	1036	936	1093	1160	4225
18–19–20	962	1430	1701	926	5019	988	937	1099	1132	4156
28–29–30	965	1422	1709	911	5007	1020	922	1108	1122	4172
April:										
7– 8– 9	980	1396	1735	942	5053	1037	928	1107	1128	4200
17–18–19	971	1403	1737	921	5032	1033	917	1125	1128	4203
Average, period 2	963	1438	1715	934	5049	1022	924	1096	1138	4179

TABLE 4

TOTAL MILK AND BUTTERFAT PRODUCTION

Cow No.	Milk in pounds		Percentage of decline	Butterfat in pounds		Percentage of decline
	Period 1	Period 2		Period 1	Period 2	
20	1348	1091	19.1	59.2	49.5	16.4
108	2205	1598	27.5	97.3	70.9	27.1
106	995	464	53.4	29.7	16.5	44.4
327	1596	1395	12.6	82.0	67.6	17.6
Group A, total	6144	4548	*26.0*	268.2	204.4	*23.8*
121	1452	1253	13.7	57.9	51.1	11.7
326	539	470	12.8	33.5	26.9	19.7
334	534	245	54.1	35.0	16.4	53.1
357	1631	1261	22.7	87.9	70.1	20.3
Group B, total	4156	3229	*22.3*	214.3	164.5	*23.2*

A certain normal decline in milk and butterfat is expected with advancing lactation, and while there is considerable variation in the decline in production among the individuals within the groups, as shown by table 4, the total average percentages of decline for both groups are practically the same. Group A, on dried orange pulp, produced 6144 pounds of milk; on dried beet pulp, 4548 pounds, or 26.0 per cent less than during the first period. Meanwhile, group B, on dried beet pulp, produced 4156 pounds of milk, and on dried orange pulp, 3229 pounds representing a loss of 22.3 per cent. The declines in butterfat production also were practically the same. Group A, when on beet pulp, gave 23.8 per cent less butterfat than when on dried orange pulp. Group B, on the other hand, gave 23.2 per cent less butterfat when on dried orange pulp than when on dried beet pulp. The slight difference is not significant in either case.

Figure 1 shows graphically the trend of milk and butterfat production during the entire experiment. That the rates of decline for both groups are similar in periods 1 and 2 has already been pointed out.

Since the amount of energy furnished by the feed was almost exactly that necessary to satisfy the requirements for maintenance and production; since the total average weights of the groups remained about constant throughout the experiment; and since there was no significant increase or decrease in milk or butterfat, whether dried orange pulp or dried beet pulp was being fed, it is evident that the two are approximately equal in value as a feed for milk production.

This observation is further substantiated by the results of a 25-day trial conducted with five grade wether sheep to determine the digestible composition of dried orange pulp for ruminants.[5]

TABLE 5

DIGESTIBILE NUTRIENTS CONTAINED IN VARIOUS COMMON FEEDS COMPARED WITH DRIED ORANGE PULP

Feeding stuff	Total dry matter in 100 pounds	Digestible nutrients in 100 pounds			
		Crude protein	Carbo-hydrates	Fat	Total*
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Dried orange pulp (5)	87.5	6.0	70.4	0.8	78.31
Barley (4)	90.7	9.0	66.8	1.6	79.40
Dried beet pulp (4)	91.8	4.6	65.2	0.8	71.60
Alfalfa hay, all analyses (4)	91.4	10.6	39.0	0.9	51.60

* Total includes fat × the factor 2.25.

According to the figures presented in table 5, dried orange pulp compares very favorably with barley in total digestible nutrients, though it is somewhat lower in amount of digestible crude protein. Dried beet pulp contains, on the average, 4.6 per cent digestible crude protein, whereas, the orange pulp used has 6.0 per cent. The total digestible nutrients in dried orange pulp is 78.3 per cent, and in dried beet pulp, 71.6 per cent. A difference in feeding value as small as these figures indicate could not be detected in a feeding trial for milk production.

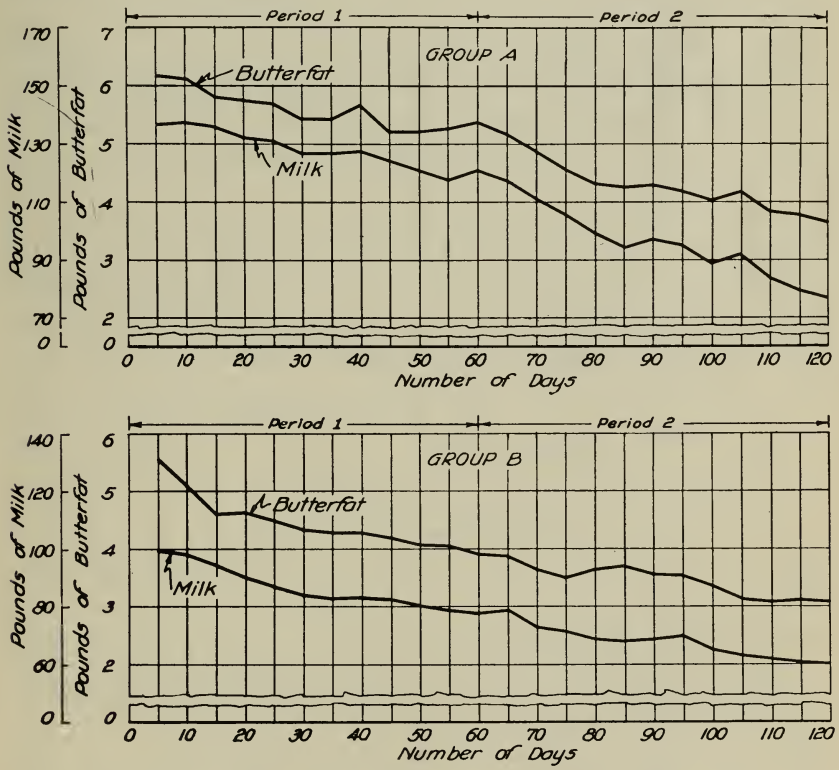

Fig. 1.—Trends in milk and butterfat production during the experiment. The figures used are five-day averages.

Dried orange pulp is not a highly palatable feed. In a preliminary test, it was refused by dairy cows when unmixed with other feeds. However, during the feeding experiment as much as eight pounds of dried orange pulp were consumed daily when mixed with an equal weight of wheat bran.

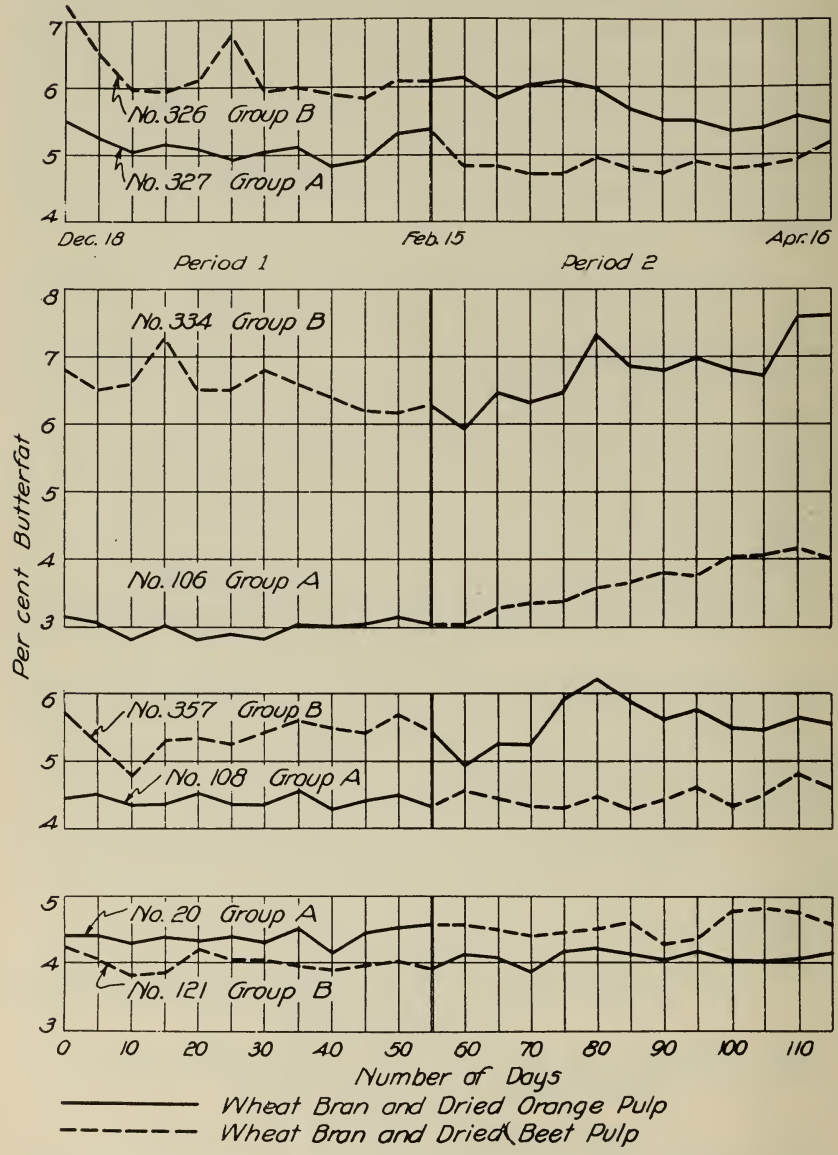

Fig. 2.—Trends in butterfat tests. The figures used are five-day averages.

Data were studied to determine what effect, if any, the feeding of dried orange pulp had on the percentage of butterfat in the milk. To facilitate graphic presentation, the daily butterfat tests were averaged for each cow so as to cover every five days throughout the experiment. These are plotted in figure 2. No effect is evident when the curves for the individual cows are compared. Cow No. 20 in group A and cow No. 121 in group B show about the same increase in percentage of butterfat, an increase that is ordinarily expected with advancing lactation. Though the averages plotted for cow No. 357 in group B are irregular, the trend of her tests is approximately the same as that of cow No. 108 in group A. Cow No. 106 in group A and cow No. 334 in group B show much the same increase. Cow No. 327 in group A and cow No. 326 in group B decreased at about the same rate. While an increase is to be expected with advancing lactation, the reverse is not uncommon for individual cows over short periods of time.

As shown in table 4, the total decline in butterfat production is 23.8 per cent for group A and 23.2 per cent for group B, a difference too small to be significant. As shown in figure 1, the curves for butterfat production are approximately the same for both groups and follow very closely those representing the trend of milk production. Thus, the feeding of dried orange pulp has no apparent effect on the percentage of butterfat in the milk.

FRESH ORANGE PULP

On the basis of dry matter, fresh and dried orange pulp should have, for all practical purposes, an equivalent feeding value. Had it not been for the case cited below, investigations with the feeding of the fresh pulp, therefore, would have been deemed unnecessary.

In 1922, Woll, of this station, studied the records of milk and butterfat production of cows in the Pellissier herd, where fresh orange pulp was being fed. He concluded as follows: "There is a strong indication that the pulp feeding in the case of practically all of the cows resulted in a marked improvement in the fat content of the milk, which was apparently progressing up to the longest period of the experimental feeding, viz., three months. The increase in the percentage of fat in the case of individual cows was frequently as much as one-half of one per cent, and in extreme cases over one per cent."

Since there is no feed known[6] which will affect a permanent increase in the butterfat test, Woll's observation, if substantiated,

would be of great scientific importance. Though the trial reported in the first part of this paper showed no effect on the butter fat test attributable to the feeding of dried orange pulp, the possibility remained that the factor responsible for the increase in test noted by Woll had been destroyed in the drying process. The experiment described in the following pages was undertaken for the purpose of obtaining definite information on this point.

METHOD OF PROCEDURE

An attempt was made to carry on this experiment at Davis, but because of the perishable nature of fresh orange pulp, it became necessary to conduct the investigation near the factory. Mr. E. C. Bennett, who maintains a large dairy herd at Chino, California, kindly offered a portion of the herd for the trial. Twenty-four grade cows were selected for this purpose. All of these were in rather poor flesh but were considerably above the average in dairy qualities. They were divided into groups, A and B, which were placed in separate corrals. That the two lots were balanced is shown in table 6. The average body weight for group A was 825 pounds and for group B, 826 pounds. The average daily milk production for group A was 28.1 pounds, while that for group B was 27.5 pounds. Group A's average test was 3.86 per cent, and group B's, 4.07 per cent. In daily butterfat production both groups were the same.

TABLE 6

INITIAL RECORDS OF BODY WEIGHTS AND PRODUCTION

Group A					Group B				
Cow No.	Weight	Daily milk	Butter fat	Daily butterfat	Cow No.	Weight	Daily milk	Butter fat	Daily butterfat
	Pounds	*Pounds*	*Per cent*	*Pounds*		*Pounds*	*Pounds*	*Per cent*	*Pounds*
121	725	27.8	4.1	1.1	96	860	29.1	4.0	1.2
122	720	26.6	3.9	1.0	123	780	32.1	3.0	1.0
125	865	33.9	3.4	1.1	124	1020	19.3	4.8	0.9
126	800	25.7	4.2	1.1	134	795	25.7	3.7	1.0
128	985	39.1	3.9	1.5	139	770	29.8	4.9	1.5
129	830	24.2	4.4	1.1	140	670	25.0	4.7	1.2
131	945	40.7	3.7	1.5	141	825	30.7	3.6	1.1
132	1035	23.8	4.1	1.0	142	880	25.0	3.5	0.9
135	555	16.9	4.8	0.8	144	800	34.7	3.2	1.1
136	1000	35.4	3.6	1.3	145	700	24.1	5.1	1.2
143	780	28.8	3.1	0.9	147	970	29.3	5.0	1.5
172	665	14.0	4.0	0.6	171	840	24.8	4.0	1.0
Totals	9905	336.9		13.0		9910	329.6		13.6
Average	825	28.1	3.86	1.1		826	27.5	4.07	1.1

The basal ration consisted of alfalfa hay and a concentrate mixture. The latter, which contained equal parts by weight of ground barley, ground corn, and dried beet pulp was fed according to production. In addition, each cow was given two pounds of cottonseed cake daily. The hay which was fed according to the average initial body weight, was placed daily in racks to which all cows of the respective groups had free access. All feeds refused were weighed and deducted from the amount given in order to arrive at the total consumption.

The feeding trial covered a period of 110 days. During the first 10 days, both groups received only the basal ration. During the next 30 days, each cow in group A received daily 20 pounds of fresh orange pulp, which replaced two pounds of alfalfa hay. As a check, group B was continued on the basal ration. During the next 30 days, the rations were reversed, group A receiving the basal ration and group B the fresh orange pulp. During the following 30 days, the rations were reversed again. During the last 10 days, only the basal ration was fed.

The cows were milked twice daily. A competent man was detailed to oversee the feeding and handling of the animals and to do all weighing, sampling, testing, and recording of data. The milk from each cow was weighed at each milking and a daily composite sample was taken for the determination of the percentage of butterfat. The cows were weighed every 30 days. The atmospheric temperature in the milking barn was recorded each morning and evening.

PRESENTATION OF DATA

For the purpose of presenting the data, the experiment was divided into periods of 10 days each. In table 7 are shown the body weights, average feed consumed, percentage of butterfat in the milk, and pounds of milk and butterfat produced. The total production of the two groups was remarkably uniform. The difference between the average percentages of butterfat for the total experimental period was only 0.01.

Because of the irregular fluctuations that are normal in the percentage of butterfat found from day to day in the milk of any dairy cow, a study of the daily tests, gives very little indication of the general trends.

In table 8 the individual tests are compiled according to the rations fed. There is no consistent indication that the feeding of fresh orange pulp has any effect upon the percentage of fat in the milk. The

tendency to increase shown in the table can logically be explained by the effect of advancing lactation. Variations as small as those between the successive periods will usually be found in any set of similar tests regardless of the ration fed.

TABLE 7

FEED CONSUMED, BODY WEIGHTS AND PRODUCTION RECORDS

(Group averages by ten-day periods)

Period	Hay	Concentrates*	Cotton-seed cake	Orange pulp	Body weight	Total milk	Butterfat	
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Per cent*	*Pounds*
				Group A				
1	190	76	20	.....	825	270.9	3.87	10.5
2	176	69	20	157.9	.....	269.7	3.90	10.5
3	170	67	20	195.2	.....	254.5	3.96	10.1
4	170	70	20	199.7	.....	284.8	3.89	11.1
5	190	70	20	.....	873	272.6	3.85	10.5
6	190	70	20	.....	.....	260.6	4.05	10.5
7	190	64	20	.....	.....	246.7	4.14	10.2
8	170	61	20	187.8	938	254.7	4.40	11.2
9	170	63	20	193.8	.....	255.9	4.39	11.2
10	170	63	20	197.3	.....	249.3	4.65	11.6
11	190	56	10	.....	.....	226.0	4.76	10.8
						2845.7	4.16	118.2
				Group B				
1	190	73	19	.....	826	274.3	4.04	11.1
2	190	71	20	.....	.....	273.6	3.82	10.5
3	190	70	20	.....	.....	278.3	3.79	10.6
4	190	71	20	.....	.....	291.3	3.74	10.9
5	170	71	20	139.5	886	284.8	4.06	11.6
6	170	71	20	197.9	.....	286.5	4.34	12.4
7	170	70	20	176.2	.....	277.5	4.53	12.6
8	190	67	20	.....	944	269.8	4.28	11.5
9	190	70	20	.....	.....	256.0	4.34	11.1
10	190	70	20	.....	.....	241.1	4.42	10.6
11	190	62	10	.....	.....	237.3	4.59	10.9
						2970.5	4.17	123.8

* Equal parts by weight of ground barley, corn meal and dried beet pulp.

In order to present a more detailed analysis of the data, the average daily butterfat tests for each group, together with average daily temperatures in the milking barn, are shown graphically in figure 3. While the temperature curve has many fluctuations, none of these correlate definitely with the variations in the butterfat curves.[7]

TABLE 8

THE EFFECT OF FEEDING FRESH ORANGE PULP ON THE FAT PERCENTAGE IN MILK

Group A						Group B					
Cow No.	Basal ration 10 days	Orange pulp 30 days	Basal ration 30 days	Orange pulp 30 days	Basal ration 10 days	Cow No.	Basal ration 10 days	Basal ration 30 days	Orange pulp 30 days	Basal ration 30 days	Basal ration 10 days
121	4.28	4.37	4.70	5.40	5.58	96	3.98	3.51	4.02	4.18	4.51
122	3.91	4.30	3.97	4.48	4.66	123	3.76	3.75	4.14	4.21	4.51
125	3.63	3.69	3.59	3.85	3.93	124	4.42	4.37	4.93	4.99	5.27
126	4.01	3.98	4.04	4.44	4.76	134	4.00	3.91	4.29	4.66	5.20
128	3.90	4.00	3.84	4.28	4.49	139	4.27	3.92	4.43	4.49	4.56
129	4.43	4.45	4.36	4.89	4.91	140	4.52	4.50	5.78	5.73	6.31
131	3.86	4.09	4.33	4.88	5.02	141	3.40	3.08	3.24	3.23	3.38
132	3.93	3.81	3.85	4.22	4.47	142	3.47	3.56	3.80	3.83	3.97
135	4.99	5.42	5.71	6.10	6.27	144	3.77	3.42	4.10	3.87	4.00
136	3.54	3.44	3.45	3.77	4.07	145	5.08	4.62	5.33	5.43	5.98
143	2.88	2.80	2.89	3.07	4.23	147	4.82	4.72	5.39	5.13	5.72
172	3.90	3.73	4.38	5.20	5.26	171	3.50	3.09	3.66	3.88	3.99
Group average	3.94	4.01	4.09	4.55	4.80	Group average	4.08	3.87	4.43	4.47	4.78

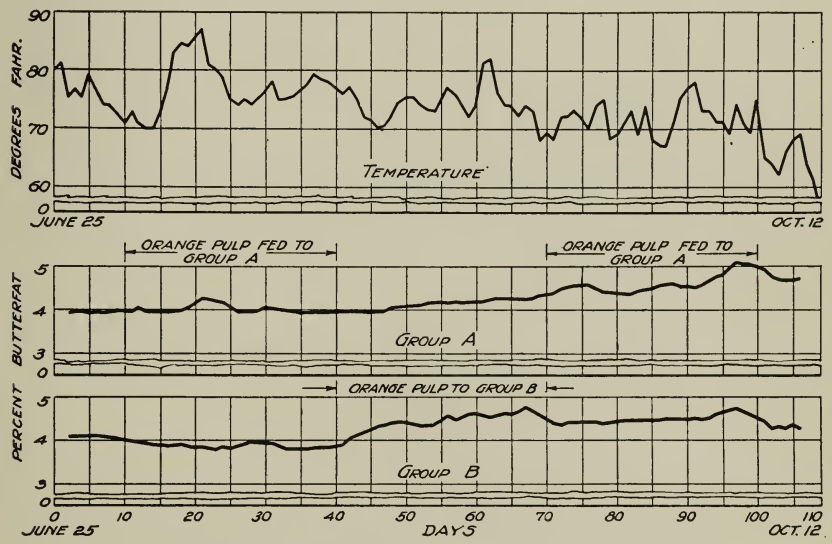

Fig. 3.—Trends in butterfat tests, and barn temperatures.

PALATABILITY

Fresh orange pulp seemed to be relished by the animals. As much as twenty pounds a day were consumed for a period of thirty days. The palatability is considerably better than that of dried orange pulp or of cull oranges. In a palatability test, incidental to the experiments recorded here, difficulty was met in inducing cows to consume more than four or five pounds of cull oranges daily. However, after a considerable time, the cows might have acquired a taste for them.

CONCLUSIONS

1. Dried orange pulp is approximately equivalent to dried beet pulp as a feed for milk production.

2. One hundred pounds of dried orange pulp contains approximately 78 pounds of total digestible nutrients.

3. Neither fresh nor dried orange pulp influenced the percentage of fat in the milk produced.

4. While fresh orange pulp was readily eaten, it was necessary to mix the dried pulp with a more palatable feed.

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